CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Utilization of concrete gives negative impacts to environment due to the production of cement consumes a lot of energy, raw materials, and carbon dioxide (CO_2) emission which lead to greenhouse effect. Hence, the concrete manufacturers are focusing on reducing the use of Ordinary Portland Cement (OPC) due to the estimation of emit 0.8-0.9 ton of Carbon Dioxide (CO_2) per ton of cement (Yang, Lee, Song, & Gong, 2014). Currently, pozzolan material is used to replace cement due to its pozzolanic effect. Pozzolan in concrete contributes to compressive strength in two ways which are by pozzolanic reaction and filler effect. Concrete with pozzolanic material contents can reduce permeability and enhance the durability of concrete (Aprianti S, 2015). From previous researcher, adding pozzolans into concrete is more effective than decreasing water/cement ratio in order to reduce permeability of chloride into concrete (Faiz U A Shaikh & Supit, 2015). Concrete interacts with chloride, the reinforcements inside concrete will be damaged and corrode faster than usual (Ragab, Elgammal, Hodhod, & Ahmed, 2016). Pozzolanic reaction tend to occur when the hydration process is fast where it create large amount of lime and initial water curing for at least 7 days is required. The product of pozzolanic reaction has C-S-H Gel where these gels will fill the voids in concrete. Thus the concrete created will be denser. Moreover, the amount of Calcium Hydroxide ($Ca(OH)_2$) will be reduced and it will enhance the durability of concrete.

Rice husk ash, sugarcane bagasse ash, hazel nutshell ashes and wheat straw ash are examples of wastes that are pozzolanic waste materials and can be used to replace cement (Aprianti S, 2015). Spent bleaching earth (SBE) is originated from the degumming and bleaching of crude palm oil and SBE is commonly disposed to landfills.

This disposal is costly and causes environmental degradation. In Malaysia nowadays, SBE is being disposed to landfills that have potential to cause fire, pollutions, hazards and green-house gas emissions (Loh et al., 2013). The residual oil from SBE will rapidly oxidizes to spontaneous auto ignition-point and giving out unpleasant odours (Mana, Ouali, de Menorval, Zajac, & Charnay, 2011). Malaysia is one of the largest producers for palm oil product in the world. So, the wastes will be generated are large in quantity. Spent Bleaching Earth (SBE) is a waste that hard to manage due to the large quantity produce, the nature of itself and the lack of way to recover it (Krzyśko-Łupicka, Cybulska, Wieczorek, Możdżer, & Nowak, 2014).

Foamed concrete is being used widely due to its' light weight property. The first ever Portland cement based foamed concrete was patented by Axel Eriksson in 1923 (Amran, Farzadnia, & Ali, 2015). In United Kingdom (UK), foamed concrete had been widely used in highway construction since 1970, but foamed concrete only being recognised as a building material at 1980 (Decký et al., 2016). Foamed concrete is low in density with the range of 400-1850kg⁄m^3. Air void distribution is one of the most important factors affect the strength (Hilal, Thom, & Dawson, 2015). Foamed concrete has a lot advantages over ordinary concrete in manipulation, possibility of treatment and repairing (Kuzielová, Pach, & Palou, 2016). Due to its low density, foamed concrete is widely used as thermal and sound insulation materials in construction. The thermal conductivity of foamed concrete is around 0.66 W/mK at density of 1600 kg⁄m^3. Meanwhile, thermal conductivity of normal concrete is 1.6 W/mK at density of 2200 kg⁄m^3 which is 59% higher than foamed concrete (Amran et al., 2015). When the density is reduced by 100 kg⁄m^3, there will be a drop of 0.04 W/mk of total thermal insulation in the case of foamed concrete. Volume of air in foamed concrete create space and it makes foamed concrete is good in thermal resistivity (Alengaram et al., 2013). The high porosity of foamed concrete makes them as a good thermal insulation material (Miled & Limam, 2016). However, there are several researchers claimed that the chloride ion resistance of concrete is depending more on porosity and inter-connectivity of the pore system and it not much depending on the chemical bonding capacity of cement (Faiz Uddin Ahmed Shaikh, 2016). Generally, durability of concrete is affected by chloride penetration subjected by sea water, de-icing salts and chloride-bearing air in marine areas. Corrosion of concrete occurred due to expansive products produced in the reaction of chloride ions with components of concrete such as $Ca(OH)_2$.

The performance of foamed concrete against chloride ingress is equivalent to an ordinary concrete with compressive strength of 25 MPa. Chloride ion and carbon dioxide will destroy the protective ferric oxide film which is stable in alkaline environment around reinforcement bar.

Thus, this study is to investigate the durability of Processed Spent Bleaching Earth (PSBE) as a partial cement replacement in foamed concrete properties under chloride environment and thermal conductivity. The objectives of this study are to investigate the compressive strength and percentage strength loss, percentage of mass change and physical deterioration of foamed concrete mixture containing 0 to 30% PSBE when exposed to chloride environment and durability of foamed concrete in term of chloride penetration and thermal conductivity of foamed concrete mixtures containing 0 and 30% PSBE.

1.2 PROBLEM STATEMENT

Utilization of concrete gives negative impacts to environment due to the production of cement consumes a lot of energy, raw materials, and carbon dioxide (CO_2) emission which lead to greenhouse effect. Globally, cements product are categories as the second most consume substance in the world whereas the first in rank is the water (Shen et al., 2014). It should be noted that, the concrete manufacturers are focusing on reducing the use of Ordinary Portland Cement (OPC) due to the estimation of emit 0.8-0.9 ton of Carbon Dioxide (CO_2) per ton of cement (Yang et al., 2014).

Foamed concrete has a lot advantages over ordinary concrete in manipulation, possibility of treatment and repairing (Kuzielová et al., 2016). Due to its low density, foamed concrete is widely used as thermal and sound insulation materials in construction. However, there are several researchers claimed that the chloride ion resistance of concrete is depending more on porosity and inter-connectivity of the pore system and it not much depending on the chemical bonding capacity of cement (Faiz Uddin Ahmed Shaikh, 2016). Principally, durability of concrete is affected by chloride penetration subjected by sea water, de-icing salts and chloride-bearing air in marine areas. Corrosion of concrete occurred due to expansive products produced in the reaction of chloride ions with components of concrete such as $Ca(OH)_2$. Chloride ion